School attendance and poverty in an oil boom context in Chad

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Abstract

Oil resources have enabled Chad to increase public financing for education and to achieve high economic growth rates. Regarding these policies to supporting the education sector, we assume that the standard of living of households does not explain the school attendance. We test empirically this hypothesis using data from the MICS conducted in 2010 and Education Statistical Yearbooks.

Using a bivariate probit model, the results show that school attendance and child labor depend of households' standard of living after controlling for other relevant characteristics. In particular, a child from a non-poor household has a lower (higher) probability to be involved in the child labor (enrolled in school) compared to a child from a poor household. Although these results are classical in the economic literature, they are rather surprising in the case of Chad regarding the priority given to education by authorities. We identify four possible explanations, (i) the low level of these investments compared to international standards; (ii) the loss of public expenditures, caused by institutional factors; (iii) the misallocation of educational infrastructures and human resources by region and (iv) an inequity sharing of spin-offs of economic growth induced by oil resources. These results raise the issue of the sustainability of the Chadian economy after oil.

Keywords: school attendance, child labor, poverty, oil resources, Chad

JEL classification: I28, J82 and Q33

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Introduction

Universal access to education is unanimously advocated by the international community both as an economic policy purpose *(Lucas, 1988; Barro, 19910; Sala-I-Martin, 1992; Ravallion and Wodon, 2000; Lee and Barro, 2000*) and as a matter of social justice (*Armartya, 1980; Kelly, 2000*). On the one hand, education contributes to economic development through the improvement in labor productivity, human capital formation and through positive externalities as a result of both. On the other hand, it provides equal opportunities for all individuals to harness theirs capabilities (*Matchinidé et al., 2006*), thus allowing to break the intergenerational transmission of poverty (*De Brauw and Hoddinott, 2008*). While the economic literature has highlighted a positive relationship between education and economic development, developing countries remain puzzled by the underlying mechanisms and this is reflected by the diversity of programs to support education. In general, two kinds of interventions are used to promote school attendance among children: educational demand and educational supply policies.

Concerning educational demand policies, they aim to increase the capacity of households to cope with education costs (direct costs - school fees, books, uniforms and the distance to school; opportunity costs related to non-participation of children in the labor market). To achieve this goal, there are two possible interventions. The first one is the implementation of structural policies to reduce poverty. The second one is ad hoc interventions such as cash or in kind transfers programs to households. The underlying hypothesis is so-called "luxury axiom" which explains school attendance by households' standard of living (*Grootaert and Kanbur, 1995; Schlemmer, 1996; Basu and Hoang Van, 1998; Filmer and Pritchett, 2001*). Indeed, in a poverty context, households' priorities can be oriented to children's participation in income-generating activities at the expense of schooling. This means that the expected yield of education is higher than the expected yield of child participation in labor market (*Jensen and Nielsen, 1997*). Education is seen as an investment which costs are borne immediately while its expected yields are uncertain. This argument reinforces the idea from *Basu and Hoang Van (1998)* according to which the child labor occurs not because of parental selfishness, but because of the concern of parents for the survival of the household, suggesting the establishment of pro-poor growth policies in order to break the intergenerational poverty transmission.

As for the educational supply policies, they consist in providing educational infrastructures, making education free, training, recruiting teachers and improving their living conditions. The provision of school facilities and teacher training improve the study conditions by reducing class sizes and allowing better monitoring of pupils (*Turner et al., 1986; Postlethwaite, 2005*). These policies are based on the assumption that improving study conditions will encourage households to enroll their children in school. However, these policies are constrained both by the availability and a better allocation of resources (*Filmer et al., 2000; Same, 2008; World Bank, 2011*). Thus, given the fact that the returns to education are observed in the long term (*Duncan and Strauss, 1998*), governments may be tempted to arbitrate in favor of policies which effects are observed in the short term (*Persson and Tabellini, 2003; Shi and Svensson, 2006; Drazen and Eslava, 2010*).

There are two types of empirical works that have focused on the evaluation of educational demand policies. On the one hand, they try to assess the effect of poverty on school performance and school attendance by using probability models. Studies at household-level show a negative (positive) relationship between poverty and school attendance (child labor). However, these studies are confronted both to the endogeneity of the poverty variable and the delicate choice of the econometric model. On the other hand, direct intervention programs for households seem to positively affect school attendance. *Schultz (2004)* assesses the impact of the program "*Progressa*" in *Mexico*, where poor mothers receive subsidies in exchange for the presence of their children at school. The author concludes that this program increases the enrollment rate of children, by an average of 3.4% for pupils from the first to the eighth grade, then that this positive effect is higher for girls (14.8%). The idea of this program is to "offset" the opportunity cost related to the non-participation of children in the labor market. But the conditional nature of this program can annihilate its real benefits[1]. *Kremer and Miguel (2004)* also assess the impact of a series of programs implemented by the *NGO International Child Support Africa* in *Kenya*, which consisted in treating intestinal worms and providing free school uniforms and school meals. The results showed that all these programs have increased school attendance and improved school performances. However, these policies raise a challenge which is their external validity.

As for the evaluation of educational supply policies, *Newman et al. (2002)* assess effects of investments from the *Social Investment Fund (SIF)* in educational infrastructures in favor of *Bolivian* rural communities. The authors found that the impact of this program on school performance is limited; however it helped to reduce the dropout rate. *Paxson and Schady (2002)* also show that the school building program in *Peru* increases school attendance rate of children aged 6 to 11 years with a better targeting of poor. However, these studies don't take into account the effectiveness of these investments which may be subject to significant losses.

Nevertheless, the educational demand and supply policies have in common the question of their financing. On the one hand, educational demand policies require the implementation of poverty reduction policies. On the other hand, educational supply policies generate costs related to the financing of educational infrastructures, free schooling, training and improvement of the living conditions of teachers. Among the different possible sources of funding for States, revenues from natural resources may ensure both the financing of educational demand and supply policies (*Segal, 2011*).

There are two competitive theories on the relationship between natural resources and education. In the first theory, natural resources generate revenues that can fund the education, making education accessible to all social strata. The underlying hypothesis is that these revenues allow to releasing the budget constraint of States which may in fact increase the volume of education financing. In the other theory, there is a negative association between natural resources and public investments in education sector. *Gylfason and Zoega (2006)* explain this negative association by the fact that rents generated by natural resources are concentrated in the hands of elites and as a result it will lead this subset of the population to invest less in the education because of her small size (*see Adam and O'Connell, 1999*). *Collier and Hoeffler (2007)* also showed that these rents affect the quality of public expenditures. Specifically, in the presence of rents, public expenditures are oriented towards patronage activities to the detriment of social investments (*Shaxson, 2007;*

Kolstad and Søreide, 2009). However, this assumes that institutions are weak and therefore people can't punish the leaders. This hypothesis is questionable in a context where the *Education For All goal* (*EFA*) is supported by the international community, and investment in education, being visible, generate political benefits (*Rogoff and Sibert, 1988*).

In reference to this literature, we test empirically the hypothesis that, by increasing the volume of public funding of the education, natural resources increase school attendance rate in Chad. More specifically, given the increase in the volume of public financing of education (education supply) and the poverty reduction of households (education demand), induced by the oil resources, we assume that the household's standard of living does not explain school attendance. The motivations of this paper are twofold. Firstly, we work on a developing country experiencing an oil boom that has allowed it to increase public financing of education and to register high economic growth rate. Secondly, we use household-level data that offer the advantage of comparing households at the same point in time and thus in similar macroeconomic conditions, unlike country and time-level data.

The choice of Chad is justified by the fact that (i) the Chadian education sector, like poor and less-developed countries, produces poor school performance in terms of access and quality[2]; (ii) Chad has incorporated education among the priority sectors, which results in an increase in the public financing of this sector[3]; (iii) no similar study was conducted to our knowledge in this country; (iv) the oil boom helped to record high growth rates which has enabled to reduce households poverty[4]; (v) Chad conducted a Multiple Indicator Cluster Survey (*MICS*) in 2010 while Chad began to exploit his oil at the end of 2003. Consequently, there is enough large temporal dimension such as the support to educational sector produces its effects.

Using a bivariate probit model, the results show that school attendance and child labor depend on the households' standard of living. In particular, a child from a non-poor household has a lower (higher) probability to be involved in the child labor (enrolled to school) compared to a child from a poor household. Although these results are classical in the economic literature, they are rather surprising in the case of Chad regarding the priority given to education by authorities. These results raise the sustainability issue of the Chadian economy after oil.

The outline of our study is composed of the following sections: Section 2 presents economic and educational environments in Chad. Section 3 presents the empirical strategy and data analysis. Section 4 is devoted to the discussion of results and robustness tests. We will conclude with some recommendations in terms of economic policies.

Economic and educational environments in Chad

Like other developing countries, Chad is hit by a high poverty rate (55% in 2003 and 46.7% in 2011), despite the presence of oil resources. Apart from that, Chad has the lowest social indicators (health and education) in the sub-region, as evidenced by its rank of 183rd out of 187 countries in 2011 according to the *index of human development of UNDP*. The education sector is characterized by a low level of school attendance. *Appendix 1*: Gross Schooling rates by country groups shows that Chad compared to different groups of

similar countries, registers the lowest gross enrollment rate, with the exception of Burkina Faso. This situation is consistent with the low level of public investment in the education sector. Indeed, according to the *Public Expenditure Review of the World Bank (2011)*, education expenditures accounted for 2.4% of GDP, or $15.7 per capita from 2000 to 2009, ranking Chad behind countries which are in the same subset than it (see

Appendix 2: Comparison of Spending on Priority Sectors).

Chad's education sector includes three levels: elementary education, secondary education and higher education[5]. The normal duration of primary education is six years and begins officially at the age of six. Secondary education includes two cycles and two sectors (general education and technical and vocational education) which can be followed both in public and private schools. The first cycle of general secondary education lasts four years, while the second cycle covers three years of study. The majority of students are enrolled in general education while vocational and technical education represents only a very small percentage (1.4%). Projections of the school-age population based on the average growth rates by age result in a primary school population (6- 11years) of 2.5 million children in 2015, that is to say 18% of the estimated total population. The Chadian educational system is subject to this current growth pace which might hinder the achievement of the *EFA goal* if no significant measures in terms of access and quality are taken.

Universal access to education remains thus a major challenge for Chadian government. The combination of economic, cultural, social, institutional and political factors explains this situation. Economic conditions affect both the demand and supply of the education. Indeed, poverty reduces the ability of households to enroll their children. Households' poverty also reduces the tax base, resulting in a low mobilization of resources for the financing of education (*Chambas, 1994; World Bank, 2007, 2011*).

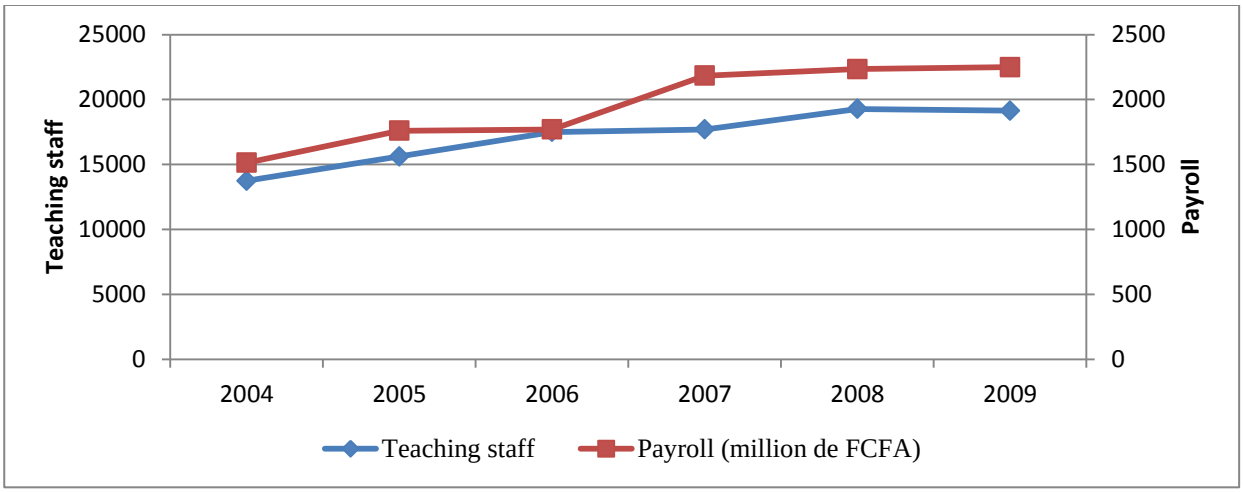
The structure of Chadian economy, based on agriculture and livestock, contributes to child labor. In fact, agriculture is the foremost economic activity, employing 73.4% of the population. These two sectors needs massively workforce and particularly child labor. This argument is consistent with the fact that the phenomenon of child labor occurs more in rural areas where agricultural and pastoral activities are prevailing. This situation is exacerbated by the school calendar, which often corresponds to the period of agricultural activities (planting, harvesting) and livestock (search of pasture, herding), leading to school discontinuity in child attendance[6]. Social and cultural norms also encourage child labor, seen as a means of socialization and education for the child's future occupations. Finally, the political situation in Chad is a bottleneck for the development of its educational system. In fact, the recurrent armed conflicts it has experienced, have contributed to break down its educational system.

Aware of this situation, and taking advantage of the availability of oil resources since late 2003, the Chadian authorities have included the education among the priority sectors of the country. The status of priority sector allows the education sector to receive significant credits financed by oil revenues. Therefore, measures have been taken in order to make education accessible to all. This vision results in the construction of educational

infrastructures, development of training, the recruitment and improvement of the living conditions of teachers, free admission to school[7] and the free provision of school canteens.

These measures have led to tangible results. According to *Statistical Yearbooks of Education 2002 to 2012*, the number of primary schools was increased on average by 6.87% per year over the period 2003 to 2010, from 5546 to 8786 primary schools.[8] This has reduced the distance to school. In fact, the number of pupils who carry out 5 km and more to reach their school went down from 25611 to 24530, that is to say a decrease of 1081 pupils. The number of classrooms has also sky rocked by 36.18%. As regards the number of teaching staff and their salary, *Figure 1* shows an upward trend for both on the period 2004-2009, representing approximately an increase by 39% and 49%, respectively. The gap between the two curves is explained in large part by the improvement of teachers' salaries, which have increased more quickly over the same period. Despite the demographic pressure; the pupil/teacher ratio has declined from 92 to 63 between 2004 and 2010.

Figure 1: Trends of number of teaching staff and their payroll



Note: Data come from Public Expenditure Review of the World Bank (2011), P. 30

From 2003 to 2010, significant investments have therefore been made in the education sector, resulting in the improvement of some indicators. We examine the effects of these investments on school attendance. Our hypothesis is that, given the massive amount of these investments, households' standard of living, measured by their poverty level, does not explain the school attendance. This assumption has several positive and normative implications including the effectiveness of the allocation of public resources in the education sector, effective forms of interventions and determinants of school attendance in Chad. Using data from *MICS 2010*, we test empirically this hypothesis.

Empirical strategy and data analysis

1. Database description and descriptive statistics

The data used come from the second Multiple Indicator Cluster Survey (*MICS*) conducted in 2010 in Chad. This survey, which covers the national territory, uses a two-stage stratified cluster sampling. At the first degree, 461 clusters were randomly selected. At the second degree, 16 386 households sampled - from the survey base established during the operation of the second General Census of Population and Habitat (*RGPH*

2) - have been effectively surveyed. Women aged between 15 and 49 years and the eligible children were interviewed. For eligible children, questionnaire is usually addressed to mothers or nurses. A total of 28 440 children aged between 5 and 14 years were surveyed. This age group is our study subjects.

The results of this survey showed that 48% of children aged between 5 and 14 years work. Girls (52%) work more than boys (48%) and children living in rural areas (50%) work more than their counterparts in urban areas. In terms of regions, children who come from *Sila* (64%), *Logone Oriental* (62%) and *Mandoul* (62%) participate more in workforce than those from *Ouaddaï* (36%) and *N'Djamena* (38%). Finally, 48% of children who work and go to school.

2. Description of variables

We use two dependent variables that are: (i) child labor (***labor***) and (ii) school attendance (***school***). These two variables are dichotomous and constructed as follows: labor takes the value 1 if the child is involved in child labor and 0 otherwise; School takes the value 1 if the child is enrolled to school and 0 otherwise. Our variable of interest is a non-monetary poverty score, calculated from the assets owned by households using the statistical procedure of principal components. The control variables are those commonly used in the literature on the determinants of school attendance and child labor; they can be classified into three categories: (i) child's characteristics; (ii) household's characteristics and (iii) the external characteristics of the household.

Child's characteristics: we use the variables age (*age*) of the child to take into account the fact that child labor is an increasing function of the age because of the physical force that is required; square of its age (*agesquare*), capturing a possible threshold effect of age; the sex of the child (*sex*) in order to see if there is a gender discrimination in child labor and school attendance; the relationship of the child with the household head (*parente*), we assume that the son/daughter of the household head has more chance to go to school than the other children living in the household.

Household's characteristics: we use the education level of the household head (*educ*) which allows to test if the educated parents have a higher probability to enroll their children compared with non-educated parents; the sex of the household head (*sex_hh*); its religion (*religion*), the household size (*size*), measured by the number of people living in the household; are the father (*father*) and mother (*mother*) of the child alive*?*

External characteristics of the household: we use the place of residence of the child (*milieu*) to test whether there is a difference between rural and urban areas following our two dependent variables. Finally, we take care to control our econometric model by regional fixed effects.

3. Choice and justification of econometric model

In this paper, we use the household-level database including 28440 households in all regions of Chad. Inspired by the previous theoretical and empirical discussions, our baseline specification is as follows:

$$\begin{cases} Y_{1i} = X_{1i}\beta_1 + u_{1i} \rightarrow (1) \\ Y_{2i} = X_{2i}\beta_2 + u_{2i} \rightarrow (2) \end{cases}$$

Where $Y_{1i}$and Y_{2i} are dichotomous variables which indicate each decision (school attendance and child labor), X_{1i} and X_{2i} are vector of control variables; β_1 and β_2 indicate coefficient matrix; $u_{1i}$and u_{2i} are error terms that we assume normally distributed. In theory, two econometric models are used to estimate these equations: probit or logit model.

In a probit or logit model, error terms u_{1i} and u_{2i} must to be white noises and their covariance null, ie Cov (u_{1i}; u_{2i}) = 0. When these two conditions are satisfied, these equations can be separately estimated. But when the independence condition of errors is not verified, i.e. Cov(u_{1i}; u_{2i}) ≠ 0, we cannot use the probit or logit model. Yet it is difficult to support the hypothesis of independence between the decision to involve the child in socio-economic activities and the one to enroll him in school. Hence we can use other three econometric models: the multinomial logit model (or conditional logit), multinomial probit model (or ordered logit multinomial) and bivariate probit model. The use of each of these models is based on specific assumptions about the distribution of error terms.

The multinomial logit model is used when the endogenous variable has several unordered modalities. However, this model requires the assumption of *Independence of Irrelevant Alternatives (IIA)*, ie the choice of an alternative is not dependent on other alternatives. It is possible to test the validity of IIA hypothesis. When this test is not conclusive, the alternative model is the multinomial probit which relaxes the IIA hypothesis because each alternative is introduced one after the other. The disadvantage of this model is that the derived probabilities are conditioned by previous choices. This means that the results will depend on the choice of order of alternatives. Consequently, the sequential approach is more appropriate for applications where the order of choice is clear. As this assumption is restrictive, we choose the bivariate probit model.

The bivariate probit model is a model with two equations estimated simultaneously, the first explaining child labor and the second school attendance. As the equations are estimated simultaneously, this model relaxes the hypothesis of an order between different alternatives and the hypothesis of IIA (*Greene, 2012, p. 738–752; Pindyck and Rubinfeld, 1998*). In other words, the bivariate probit model takes into account the possibility of correlation between the residuals of two equations. This model has been used in many empirical studies dealing with the determinants of child labor and school attendance (*Adjiwanou,* 2005; *Diallo, 2008; Beffy et al.; 2009).*

Empirical evidence

1. Estimation of determinants of child labor and school attendance

Table 1: Determinants of child labor and school attendance presents the results of the estimation of equations (1) and (2). Regressions in columns (1) to (3) use child labor (labor) as dependent variable while the columns (4) to (6) use school attendance (school) as endogenous variable. Before interpreting our results, we verify whether the regression diagnostics are valid.

First, we notice that the coefficient (rho) indicating the correlation between the residues of equations (1) and (2) is statistically significant in all our estimates, justifying the use of bivariate probit model. This coefficient

is positive, we believe that omitted variables that increase the probability of a child of being involved in child labor affect positively the probability of a child of being educated. Secondly, we notice that the p-value associated to Chi-square statistic is null in all our regressions, implying that we can reject the hypothesis that all coefficients are jointly equal to 0. We remind that we are interested in the direction of the relationship between our variables and not the magnitude of this relationship that is why we do not calculate the marginal effects of variables.

In column (1) we use a binary variable as the variable of interest (*poor*). The coefficient of this variable is significantly negative, which means that the belonging of a child to a non-poor household decreases the probability that he is involved in the child labor compared to a child from a poor household. In column (2) we use the poverty score (continuous variable) as the variable of interest in order to avoid choosing an arbitrary threshold to distinguish poor from non-poor. We find that the more the poverty score increases, the less is the probability that the child is involved in the labor market. In column (3), we divide the sample into quintiles (from the 1st to the 5th quintile), depending on the poverty score. Not surprisingly, we find that when the household quintile increases, the probability that a child from this household is involved in socio-economic activities decreases significantly. These same results occur inversely for school attendance in the sense that all the poverty variables affect significantly and negatively school attendance (columns (4) to (6)). Although these results are classical, they are rather surprising in the case of Chad considering priority given to education by authorities, resulting in a dizzying rise of the financing of education. We identify four possible explanations.

First, the level of funding in the education's sector may be questioned because despite these significant investments, some indicators such as average education spending per capita, supervision rate and the number of students/class are lackluster compared to similar countries. This is consistent with the figures of the

Appendix 4 where less than half (41.77%) of primary schools are public. Others are mostly private or community schools. However, access to a private school leads to higher direct costs (tuition) for households compared to access to a public school. Furthermore, the functioning of a community school requires financial and in kind participations of communities[9]. Finally, based on the numbers of pupils in 2008/2009, the Ministry of National Education has estimated to 23,201 the number of additional primary schools necessary to meet international standards in terms of study conditions (pupils/class). In this context, it seems reasonable that the households' living standard is a relevant variable in explaining school attendance.

Secondly the loss of public expenditures can explain this result. Thus, data on the financing of education are collected at the central level (Ministry of Finance and Budget, and Ministry of Education), which doesn't actually ensure their destination. This hypothesis seems plausible because the hierarchical structure of the Chadian education system can lead to considerable loss of public resources in the allocations from central to decentralized units. The weak institutional quality could also foster a significant loss of public resources.[10]

Third, we question the effectiveness of public expenditures in the education sector. Indeed, the distribution of educational infrastructure and the allocation of teaching staff by region may not respond to the needs of recipient areas. One would expect that the allocation criterion of physical, financial and human resources by administrative area would be the number of pupils and the region size. We notice that the standard deviations of pupils/teacher and pupils/primary school ratios are 18 and 73. Minima of these ratios are achieved in *N'Djamena* and in *Lac-Tchad*, which are not the largest regions of Chad.

Finally, oil resources has allowed Chad to record high economic growth rates over the past decade. However, if this growth is badly redistributed, it might not contribute to reduce household poverty and thus their ability to address direct and indirect costs of education. This could lead households to arbitrate in favor of children's participation in the labor market instead of investing in education (*Basu and Hoang Van, 1998*). Such arbitration is reinforced by the employment prospects, which if they are not favorable, the expected return of child education is lower than his participation in the labor market. Finally, a part of the literature on the "natural resource curse" supports the idea that oil resources increase social inequalities (*Sachs and Warner, 1995; Bulte et al. 2005; Gylfason, 2001a*), reducing the ability of a large part of the population to face education costs.

Table 1: Determinants of child labor and school attendance

Dependent variable	labor[1]			school[2]		
	(1)	(2)	(3)	(4)	(5)	(6)
_cons	-3.197***	-3.188***	-3.180***	-4.200***	-3.794***	-4.033***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Interest variables						
No poor[3]	-0.0712***			0.454***		
	(0.000)			(0.000)		
poverty index		-0.127***			0.339***	
		(0.000)			(0.000)	
2nd quintile			-0.0632**			0.129***
			(0.014)			(0.000)
3rd quintile			-0.0892***			0.345***
			(0.001)			(0.000)
4th quintile			-0.0848***			0.679***
			(0.004)			(0.000)
5th quintile			-0.244***			0.950***
			(0.000)			(0.000)
Child' characteristics						
Age	0.583***	0.584***	0.585***	0.824***	0.831***	0.831***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
agesquare	-0.0229***	-0.0229***	-0.0230***	-0.0380***	-0.0385***	-0.0384***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
female[4]	0.468***	0.470***	0.469***	-0.311***	-0.313***	-0.313***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
parente[5]	0.0128	0.0191	0.0139	-0.0559**	-0.0656**	-0.0640**
	(0.617)	(0.457)	(0.587)	(0.038)	(0.015)	(0.018)
Household' characteristics						
primary[6]	-0.0626***	-0.0404*	-0.0501**	0.491***	0.459***	0.456***
	(0.009)	(0.094)	(0.038)	(0.000)	(0.000)	(0.000)
Second and plus	-0.127***	-0.0547*	-0.0925***	0.754***	0.650***	0.652***
	(0.000)	(0.054)	(0.001)	(0.000)	(0.000)	(0.000)
female	-0.0386	-0.0359	-0.0387	0.165***	0.149***	0.161***
	(0.133)	(0.162)	(0.132)	(0.000)	(0.000)	(0.000)
catholic[7]	-0.221***	-0.210***	-0.211***	0.0205	0.0322	-0.0138
	(0.000)	(0.000)	(0.000)	(0.712)	(0.561)	(0.804)
protestant	-0.231***	-0.215***	-0.219***	0.0559	0.0796	0.0083
	(0.000)	(0.000)	(0.000)	(0.311)	(0.148)	(0.881)
muslim	-0.384***	-0.307***	-0.345***	-0.519***	-0.641***	-0.657***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
other religion	-0.652***	-0.636***	-0.641***	-0.143	-0.116	-0.190
	(0.000)	(0.000)	(0.000)	(0.279)	(0.372)	(0.150)
size	-0.0202***	-0.0169***	-0.0193***	0.0001	-0.0081***	-0.0040*
	(0.000)	(0.000)	(0.000)	(0.983)	(0.000)	(0.065)
mother alive[8]	0.00403	0.0198	0.0119	0.173***	0.138***	0.163***
	(0.932)	(0.675)	(0.800)	(0.001)	(0.006)	(0.001)
father alive[9]	0.0372	0.0336	0.0363	-0.0147	0.00614	-0.00585
	(0.271)	(0.321)	(0.283)	(0.675)	(0.861)	(0.868)
Area residence						
rural[10]	0.0316	-0.0328	-0.00708	-0.274***	-0.223***	-0.0998***
	(0.120)	(0.109)	(0.752)	(0.000)	(0.000)	(0.000)
Sample size	27084					
rho	0.0584**	0.0719**	0.0661**	0.0584**	0.0719**	0.0661**
Prob > chi2	0.000	0.000	0.000	0.000	0.000	0.000

p-values in parentheses *p<0.10, ** p<0.05,***p<.01

(1) labor takes the value 1 if the child works, 0 otherwise; (2) school takes the value 1 if the child is enrolled, 0 otherwise; (3) base=poor; (4) base=boy; (5) base=son/daughter of household head; (6) base=no educated; (7) base =animist; (8) base=mother alive; (9) base=father alive; (10) base = urban. Regional fixed effects are summarized in *Appendix* 3.

As regards the child's characteristics that affect his participation in the labor market, we notice the significant and positive influence of the variable age. This could be explained by the fact that the tasks performed by children are generally manual and physical requiring no special education, but some physical ability to run them (*Andvig, 1998*). This is why the more the child grows, the more he is able to be involved in labor market. However, the relationship between participation in the labor market and age makes appear a threshold effect. Indeed, the term square age is significantly negative, indicating that the probability of participation in the labor market increases with age until a certain threshold after which it decreases. The results also reveal gender discrimination because the probability of participation in the labor market is significantly greater for girls than for boys. Finally, gender discrimination is also observed in terms of school attendance because being a girl reduces the probability to be enrolled in school compared to a boy. This sociological result is explained by the fact that girls are prepared to be wives and consequently housework would prepare them to take on this role. While the education of boys, who will bear the future burden of family, is a family insurance. However, the link of the child with the household head influences significantly and negatively school attendance, suggesting that sons of the household head are more likely to be enrolled in school than any other child living in the household. In a poverty context, the household head may prioritize the education of its own children at the expense of other children living in the household because the excepted return of his own sons' education could constitute a better guarantee for the future survival of the household.

Household's characteristics that influence significantly the participation in labor market are the education level of the household head, its religion and the household size. Non-educated household heads are more likely to involve their children in socio-economic activities than those who are educated (primary and secondary schools or higher). Two transmission channels could be identified, namely poverty and socio-professional status of the household head. On the one hand, the theory of human capital explains the income of an individual by its education level (*Angrist and Krueger, 2001*), suggesting that a household head without education is more likely to be poor. On the other hand, a household head without education is likely to be involved in primary activities (agriculture, livestock...); these activities are those which need more child labor. We find that a household head belonging to a particular religion has a significantly lower probability to involve his children in labor market, compared to an animist household head. The household size, measured by the number of people living in the household, negatively affects the probability that a child is involved in socio-economic activities. As regards school attendance, we notice that the education level of the household head affects significantly and positively the probability that a child is enrolled in child labor, which is an excepted result. It is also worth noting that the fact that a household head is a woman and the mother of the child is alive increase significantly and positively the probability of school attendance. This is consistent with the thesis that the well-being of children is best served by women, especially when they have the decision-making power (*Handa, 1994; 1996; Lloyd and Blanc, 1996; Banerjee et al., 2010*). As regards the religion of the household head, only Muslim household heads are less likely to send their children to school. This last result is consistent with the history of Chad as the Muslim community has strongly resisted the colonial conquest of Chad and therefore considered "white school" as a domination instrument. It is therefore possible that such perception of the school persists until today.

The child's place of residence, unexpectedly, does not explain the participation of children in the labor market. Nevertheless, for the attendance, we notice that living in rural area significantly reduces the probability that a child is educated. This result may be explained by household poverty because poverty is a predominantly rural phenomenon in Chad (*ECOSIT 3 report*).

As regards the regional fixed effects, we take the region of *N'Djamena* as the reference category. We notice that the probability that a child participates in the labor market is higher in all regions compared to the region of *N'Djamena*, with the exception of those of *Ouaddai and Wadi Fira*. Concerning the school attendance, these results are inverted and raise the issue of equity in public expenditure allocation in the education sector.

2. Robustness tests

We try to see if there is a significant difference between the region of *Logone Oriental (LO)* and the other regions in terms of school attendance and child labor. Indeed, in addition to regular resources all regions benefit, this region receives 5% from oil revenues as a region producing oil. Overall, these additional resources have served to build educational and health infrastructure, and roads. They were also used to develop income-generating activities through microcredit. To do this, we make a test of the difference of means of school attendance and child labor variables, each region compared to the region of LO. The results are summarized in the table in

Appendix 5. Overall, results show that child labor is significantly dominant in the region of LO. However this situation does not divert children from school because school attendance seems more prevalent in the region of LO than in other regions. But if we compare the region of LO with its geographical neighbors (*Logone Occidental, Mandoul, Tandjilé and Mayo-Kebbi Ouest*), we find that school attendance is significantly higher in neighboring regions compared to the region of LO.

Keeping in mind the above idea about LO, we look through the results of the regressions at whether the fact that a child belongs to the region of LO gives him more opportunity to be educated. To do this, we maintain our basic specification (Eq. 1) and we modify only the variable region which has the region of LO as the new reference category and not *N'Djamena*. This technique has the advantage of controlling the relationship by other variables, which may not be done with a simple test of difference of means. The results, summarized in Table in *The test* of the difference of means of school attendance and child labor variables consists to do means (each region) – mean (region of LO)

Appendix 6, are consistent with those obtained previously. Indeed, the fact that a child belongs to an other region than the region of LO decreases significantly the probability that he is involved in child labor, with the exception of *Mandoul*. We also find that the probability that a child comes from a different region than the region of LO is significantly higher than that the one of a child from the LO. These results seem to corroborate our main result that is oil resources invested in education sector did not encourage school attendance. They raise at the same time the issue of efficiency of the 5% allocation of oil revenues.

Conclusion and recommendations

In this article, we investigated the relationship between public investment in the education sector and school attendance in Chad. Taking advantage of the availability of oil resources, this country has increased public education financing and has recorded high economic growth rates. The education financing includes building educational infrastructure, train, recruiting teaching staff and improving their living conditions, making the school free and providing school canteens. We assume that, given the support of these policies to the education sector, households' living standard does not explain the school attendance. We tested empirically this hypothesis using data from the MICS conducted in 2010. To do this, we used two dichotomous dependent variables, namely school attendance and child labor. The independent variable is a score of non-monetary poverty, calculated from the assets owned by the households using the statistical procedure of principal components.

Using a bivariate probit model, the results show that school attendance and child labor depend of the household's standard of living. In particular, a child belonging to a non-poor household has a low probability to be involved in the child labor and a high probability to be enrolled in school compared to a child from a poor household. These results, classical in the economic literature, constitute a challenge to Chadian education system because education is placed among public priority sectors. We identified four possible explanations, (i) the low level of these investments compared to international standards; (ii) the loss of public expenditures, caused by institutional factors; (iii) the misallocation of educational infrastructures and human resources by region and (iv) an inequitable sharing of spin-offs of economic growth induced by oil resources. These results raise the sustainability issue of the Chadian economy after oil.

The next step in this line of research would be investigating empirically different transmission channels mentioned above. It would also be interesting to extend the study to the link between these investments and school outcomes.

Notes

[1] (i) conditional transfers (CT) generate administrative costs; (ii) CT divert the program for the benefit of non-needy if the poor meet conditionalities; (iii) CT generate an unequal division of tasks among the members of the household (e.g. women concerned often to accompany children to the hospital); (iv) they create corruption because those who are responsible for monitoring can request payments to beneficiaries.

[2] High dropout rate, schools with incomplete cycles, low external and internal efficiency; high supervision rate (on average one teacher per 63 pupils in primary schools) and a low investment in education infrastructures (on average of 61 pupils per class and 161 if there is only the class of durable materials).

[3] These are (i) health and social services; (ii) Education, (iii) Infrastructure; (iv) Rural development and (v) water. According to law *001/PR/1999*, priority sectors benefit from 80% of direct oil resources (dividends and royalties); 5% for the producing

[4] According to *ECOSIT 3* data, the poverty rate is passed on average of 55 to 46.7%, while that rural poverty is passed of 80 to 52% over the period 2003 and 2011.

[5] According to Stratégie Nationale de l'Alphabétisation 2013-2015, we can add the preschool, which is less developed (gross enrolment rate of 2.5%). 9 over 23 regions that also account the Chad haven't preschool.

[6] School year officially starts on October 1st and ends on June 30. Moreover, periods of agricultural activities take place between May and December. School discontinuity may cause poor school performances, which in turn may lead children to drop out of school.

[7] See Article 35 of the Chadian constitution revised in 2005, which states that every citizen has the right to education and that education is secular and free. This has been taken up by law 16/PR/2006 of 13 March 2006 on the orientation of the Chadian education system.

[8] There are three different school types in Chad. Public, private (secular, catholic, protestant) and community schools.

[9] A community school is funded by the development partners of Chad, the State and the beneficiary communities. Therefore its operation involves a strong participation of beneficiary households in terms of infrastructure and of taken charge of teachers,

[10] *Corruption perception index* from *Transparency International* classes Chad 171st out of 178 countries in 2010. This could explain in large part the loss of public expenditures. The first *Public Expenditure Tracking Survey* in the health sector in 2003, which the report has not been published because Chadian government has not validated it, showed that only 1% of non-wage health expenditures to regional health administrations arrived at the health facility level (see *Moss, 2011 p. 12*).

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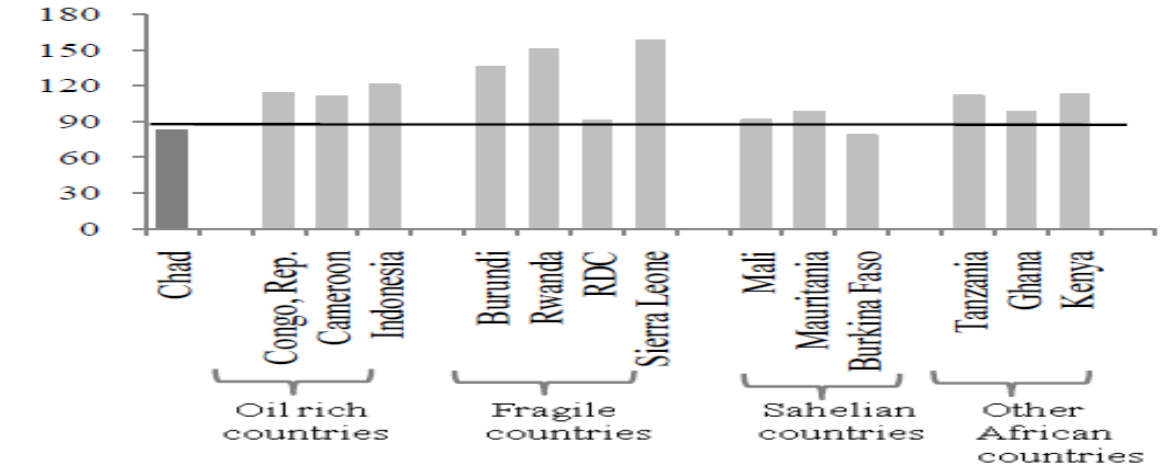
Appendix

Appendix 1: Gross Schooling rates by country groups



Source: WDI, 2009
Note: All data from 2008-09

Appendix 2: Comparison of Spending on Priority Sectors

	Chad	Republic of Congo	Indonesia	Tanzania	Cameroon	Rwanda
(Percent of GDP)						
	Average 2006-09	Average 2004-08	Average 2006-07	Average 2003-04	Average 2005-06	2007
Select Priority Sectors	**9.5**	**7.2**	**8.5**	**12**	**5.6**	**11.6**
Education	2.4	2.0	4.1	5.1	3.0	5.2
Health	1.0	1.8	1.1	2.7	0.8	2.6
Rural Development	2.8	0.6	0.6	3.2	0.4	1.0
Infrastructure	3.4	2.8	2.6	1	1.4	2.8
(US$/Cap)						
	Average 2006-09	Average 2004-07	Average 2006-07	Average 2003-04	Average 2007-07	2007
Select Priority Sectors	**62.7**	**127.2**	**78.9**	**88.7**	**82.3**	**31.6**
Education	15.7	36.9	38.0	56.8	39.6	18.3
Health	6.4	35.2	10.5	5.8	11.5	9.0
Rural Development	18.2	11.2	6.0	8.5	5.8	3.5
Infrastructure	22.5	43.9	24.4	17.6	25.4	9.6

Note: Data includes external funding.
Source: IMF; World Bank; Bank of Tanzania; Bank of Indonesia; Ministry of Finance Republic of Congo

Appendix 3: Regional fixed effects (base *N'Djaména*)

Dependent variable	**Child labor**			**School attendance**		
Interest variable	**No poor**	**Poverty index**	**Poverty quintile**	**No poor**	**Poverty index**	**Poverty quintile**
Batha	0.660*** (0.000)	0.443*** (0.000)	0.579*** (0.000)	-0.401*** (0.000)	0.106* (0.075)	-0.208*** (0.000)
BET	0.355*** (0.000)	0.141** (0.025)	0.282*** (0.000)	-0.258*** (0.000)	0.271*** (0.000)	-0.0590 (0.349)
Chari Baguirmi	0.104* (0.063)	-0.0894 (0.128)	0.0397 (0.488)	-0.625*** (0.000)	-0.122* (0.051)	-0.526*** (0.000)
Guera	0.458*** (0.000)	0.222*** (0.000)	0.368*** (0.000)	-0.0800 (0.113)	0.454*** (0.000)	0.155*** (0.004)
Hadjer lamis	0.218*** (0.000)	0.00557 (0.923)	0.147*** (0.008)	-0.703*** (0.000)	-0.184*** (0.003)	-0.540*** (0.000)
Kanem	0.572*** (0.000)	0.349*** (0.000)	0.491*** (0.000)	-0.464*** (0.000)	0.107* (0.078)	-0.256*** (0.000)
Lac	0.562*** (0.000)	0.336*** (0.000)	0.479*** (0.000)	-0.545*** (0.000)	0.0422 (0.493)	-0.331*** (0.000)
Logone Occidental	0.204*** (0.000)	0.0381 (0.530)	0.150** (0.011)	-0.256*** (0.000)	0.151** (0.023)	-0.115* (0.075)
Logone Oriental	0.570*** (0.000)	0.392*** (0.000)	0.511*** (0.000)	-0.384*** (0.000)	0.00307 (0.963)	-0.245*** (0.000)
Mandoul	1.059*** (0.000)	0.883*** (0.000)	1.001*** (0.000)	-0.297*** (0.000)	0.0898 (0.172)	-0.162** (0.011)
Mayo Kebbi Est	0.203*** (0.000)	0.0196 (0.737)	0.142** (0.011)	-0.184*** (0.002)	0.216*** (0.001)	-0.0298 (0.620)
Mayo Kebbi Ouest	0.411*** (0.000)	0.209*** (0.000)	0.342*** (0.000)	-0.259*** (0.000)	0.214*** (0.001)	-0.0948 (0.132)
Moyen Chari	0.500*** (0.000)	0.336*** (0.000)	0.453*** (0.000)	-0.0166 (0.796)	0.379*** (0.000)	0.0966 (0.140)
Ouaddaï	-0.0755 (0.172)	-0.289*** (0.000)	-0.156*** (0.006)	-0.263*** (0.000)	0.203*** (0.001)	-0.0634 (0.282)
Salamat	0.0813 (0.128)	-0.150** (0.010)	-0.00364 (0.948)	-0.469*** (0.000)	0.0424 (0.486)	-0.237*** (0.000)
Tandjilé	0.346*** (0.000)	0.161*** (0.006)	0.281*** (0.000)	-0.235*** (0.000)	0.190*** (0.003)	-0.0774 (0.209)
Wadi Fira	-0.0239 (0.682)	-0.234*** (0.000)	-0.101* (0.090)	-0.525*** (0.000)	-0.0707 (0.279)	-0.348*** (0.000)
Barh EL Gazal	0.305*** (0.000)	0.0871 (0.136)	0.235*** (0.000)	-0.453*** (0.000)	0.0970 (0.111)	-0.267*** (0.000)
Sila	0.475*** (0.000)	0.245*** (0.000)	0.387*** (0.000)	-0.221*** (0.000)	0.318*** (0.000)	0.0137 (0.812)

Appendix 4: Mains indicators of Chadian' education system by region

Region	Indicators					
	Public primary schools	**Total primary schools**	**Public schools/ Total Schools (%)**	**Pupils/teacher rate**	**pupils/class rate**	**Average class size**
Batha	136	329	41.34	83	89	76
BET	79	96	82.30	69	64	28
Chari Baguirmi	149	349	30.47	54	59	46
Guera	236	489	48.26	67	73	95
Hadjer lamis	117	301	38.87	68	76	46
Kanem	117	257	45.53	120	106	69
Lac	136	270	50.37	68	60	40
Logone Occidental	195	654	29.82	61	62	117
Logone Oriental	406	895	45.36	61	63	123
Mandoul	203	701	28.96	59	59	120
Mayo Kebbi Est	381	732	52.05	59	60	106
Mayo Kebbi Ouest	277	558	49.64	56	57	120
Moyen Chari	196	589	33.28	59	59	117
Ouaddaï	216	536	40.30	82	93	91
Salamat	75	215	34.88	89	101	71
Tandjilé	402	805	49.94	58	58	115
Wadi Fira	148	282	52.48	86	81	52
N'Djamena	110	416	26.44	49	65	124
Barh EL Gazal	33	146	22.60	75	85	48
Sila	58	166	34.94	96	100	88
Total	**3670**	**8786**	**41.77**	**63**	**63**	**91**

Appendix 5: Comparison of regions by result variable

Region compared to Logone Oriental	Child labor		School attendance	
	Mean difference	**P-value**	**Mean difference**	**P-value**
Batha	-.0090	0.6316	-.2823***	0.0000
BET	-.1241***	0.0000	-.1459***	0.0000
Chari Barguirmi	-.1974***	0.0000	-.2661***	0.0000
Guéra	-.0752***	0.0000	-.1502***	0.0000
Hadjer Lamis	-.1617***	0.0000	-.3434***	0.0000
Kanem	-.0304	0.1187	-.2417***	0.0000
Lac	-.0290	0.1370	-.2909 ***	0.0000
Logone Occidental	-.1226***	0.0000	.0589***	0.0020
Mandoul	.1600***	0.0000	-.0101	0.5947
Mayo Kebbi Est	-.1334***	0.0000	-.0296*	0.0904
Mayo Kebbi Ouest	-.0740	0.0001	.0340*	0.0604
Moyen Chari	-.0285	0.1429	.1348***	0.0000
Ouaddaï	-.2590***	0.0000	-.2760***	0.0000
Salamat	-.2142***	0.0000	-.3074***	0.0000
Tandjilé	-.0648***	0.0004	.0459***	0.0088
Wadi-Fira	-.2515***	0.0000	-.3211***	0.0000
N'Djaména	-.2513***	0.0000	.1294***	0.0000
Barh El Gazal	-.1358	0.0000	-.2695***	0.0000
Sila	-.0797	0.0000	-.2231***	0.0000

The test of the difference of means of school attendance and child labor variables consists to do means (each region) – mean (region of LO)

Appendix 6: Regional fixed effects Effets (base Logone Oriental)

Dependent variable	**Labor**	**School**
Interest variable	**Poverty score**	
Batha	0.0898 (0.134)	-0.0169 (0.787)
BET	-0.215*** (0.001)	0.126* (0.066)
Chari Baguirmi	-0.466*** (0.000)	-0.241*** (0.000)
Guera	-0.112** (0.046)	0.304*** (0.000)
Hadjer Lamis	-0.352*** (0.000)	-0.319*** (0.000)
Kanem	0.00168 (0.978)	-0.0795 (0.215)
Lac	-0.00842 (0.891)	-0.161** (0.013)
Logone Occidental	-0.366*** (0.000)	0.128** (0.025)
Mandoul	0.489*** (0.000)	0.0874 (0.114)
Mayo Kebbi Est	-0.367*** (0.000)	0.200*** (0.000)
Mayo Kebbi Ouest	-0.159*** (0.003)	0.125** (0.027)
Moyen Chari	-0.0698 (0.194)	0.367*** (0.000)
Ouaddai	-0.646*** (0.000)	0.121* (0.059)
Salamat	-0.489*** (0.000)	-0.0854 (0.174)
Tandjilé	-0.224*** (0.000)	0.149*** (0.005)
Wadi Fira	-0.594*** (0.000)	-0.141** (0.039)
N'Djaména	-0.570*** (0.000)	0.384*** (0.000)
Barh El Gazal	-0.265*** (0.000)	-0.0686 (0.285)
Sila	-0.0954 (0.113)	0.163*** (0.010)